Humans to the Martian System

Preliminary Summary of Strategic Knowledge Gaps

P-SAG (jointly sponsored by MEPAG and SBAG)

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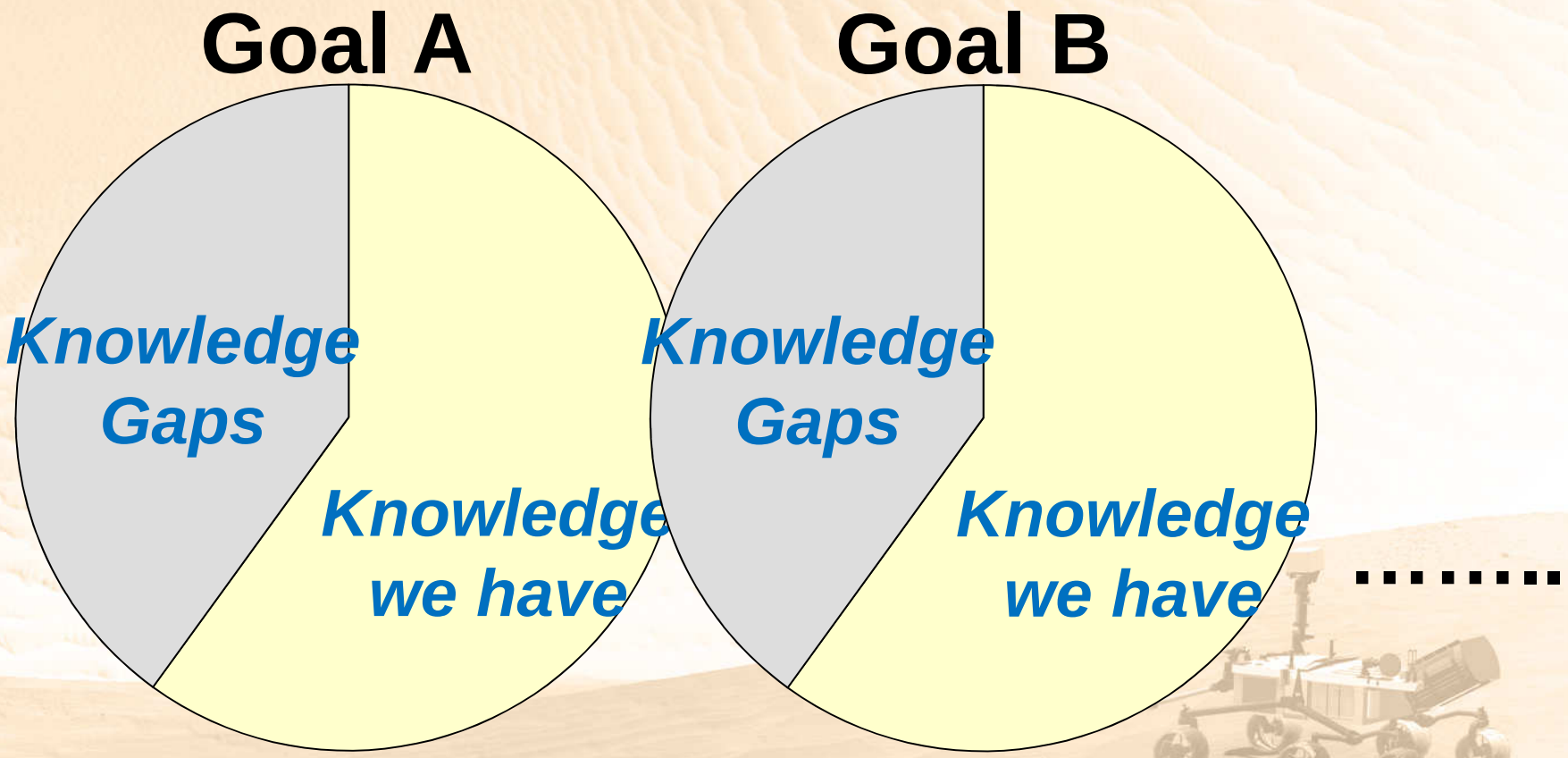
PREDECISIONAL FOR PLANNING AND DISCUSSION PURPOSES ONLY

Strategic Knowledge Gaps

The Gap in Knowledge Needed to Achieve a Specific Goal



Structure of the Information

SKGs | **Knowledge-generating activity** | **Meas. needed** | **Priority**

For Goal A

SKG #1	*Mars Flight investigations*		
	Non-flight		
	Technology Dev./demo		
SKG #2	*Mars Flight investigations*		
	Non-flight		
	Technology Dev./demo		

For Goal B

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Initial List of SKGs

GROUP A. To Achieve the Goal of Humans to Mars Orbit

1. Upper Atmosphere. The current Martian atmospheric observations (density, pressure, temperature, aerosols and dynamics) have significant limitations for supporting aerocapture and aerobraking design, especially for human-scale missions.
2. Atmospheric Modeling. The atmospheric models for Mars have not been well validated due to a lack of sufficient observational data, and thus our confidence in them (for use in mission engineering) is significantly limited.
3. Orbital Particulates. We have insufficient information about the orbital particulate environment in high-Mars orbit.
4. Technology: To/from Mars System. In addition to the specific challenges listed above, we do not have the required technology available to: (1) sustain human life during long duration flight to/from Mars and around Mars; (2) launch and return human-scale payloads to/from Mars orbit.

NOTE: Priorities not finalized.

Initial List of SKGs

GROUP B. To Achieve the Goal of Humans to the Martian Surface

All of the elements of GROUP A plus:

1. **Lower Atmosphere.** We do not have sufficient Martian atmospheric observations to confidently model winds, which significantly affect EDL design, or atmospheric electricity, in the forms of electric fields and conductivity, to understand the risks to ascent vehicles, ground systems, and human explorers.
2. **Back Contamination to Earth.** We do not know whether the Martian environments to be contacted by humans are free, to within acceptable risk standards, of biohazards that might have adverse effects on some aspect of the Earth's biosphere if uncontained Martian material were returned to Earth.
3. **Radiation.** We do not understand in sufficient detail the ionizing radiation environment at the Martian surface, including contributions from the energetic charged particles that penetrate the atmosphere, secondary neutrons produced in the atmosphere, and secondary charged particles and neutrons produced in the regolith.

NOTE: Priorities not finalized.

Initial List of SKGs

4. Dust Effects. We do not understand the possible adverse effects of Martian dust on either the crew or the mechanical/electrical systems.
5. Water Resources. We do not fully understand if a water resource on Mars occurs in a form that could change the high-level architecture of future human missions to the surface.
6. Forward Contamination to Mars. We are not able to predict with sufficient confidence the potential consequences of the delivery and subsequent dispersal of a large bioload associated with a future human mission to the martian surface.
7. Atmospheric ISRU. We do not understand in sufficient detail the properties of atmospheric constituents near the surface to determine the adverse effects on ISRU atmospheric processing system life and performance within acceptable risk for human missions.
8. Landing Site and Hazards. We do not yet know of a site on Mars that is certified to be safe for human landing, and for which we understand the type and location of hazards that could affect the ability to safely carry out mobile surface operations.

NOTE: Priorities not finalized.

Initial List of SKGs

9. <u>Technology: Mars Surface.</u> In addition to the specific challenges listed above, we do not have the required technology available to: (1) land human-scale payloads on the martian surface; (2) sustain humans on the surface of Mars; (3) enable human mobility and exploration of the Mars surface environment; all within acceptable risk.

NOTE: Priorities not finalized.

Initial List of SKGs

GROUP C. To Achieve the Goal of Humans to Phobos/Deimos

All of the elements of GROUP A plus:

1. Phobos/Deimos surface Science. We do not have enough understanding of the geological, compositional, and geophysical properties of Phobos and Deimos in order to design focused human-based scientific investigations and engineering activities with precise objectives like those now possible for the Martian surface.
2. Phobos/Deimos surface Ops. We do not know how to perform close proximity and surface interactions (docking/anchoring/mobility) in the conditions present near/at the surface of the martian satellites (low gravity/loose regolith/significant temperature variations/etc.) in order to carry out probable human-based scientific investigations and engineering activities.

NOTE: Priorities not finalized.